Length Frequency

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Data Preparation

I will now compare the length frequency distribution for largemouth bass obtained in the nearshore electrofishing survey during 2013 - 2016.

```
lmb <- read.csv("Data/Clean-Data/2012-2017_nearshore-survey-largemouth-bass_CLEAN.csv") %>%
    arrange(Year, FID, Length)
lmb$fyr <- as.factor(lmb$fyr)

str(lmb)
```

```
## 'data.frame':    539 obs. of  16 variables:
##  $ Year  : int  2012 2012 2012 2012 2012 2012 2012 2012 2012 2012 ...
##  $ Site  : int  18 18 18 18 18 18 18 18 18 18 ...
##  $ FID   : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ Weight: num  8 10 10 30 25 20 40 155 145 170 ...
##  $ Length: int  72 82 85 108 110 115 119 220 220 230 ...
##  $ AC    : int  2 2 2 2 2 2 2 2 3 3 ...
##  $ AGE   : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ SexCon: int  NA NA NA NA NA NA NA NA NA NA ...
##  $ Sex   : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ Delts : logi  NA NA NA NA NA NA ...
##  $ logW  : num  0.903 1 1 1.477 1.398 ...
##  $ logL  : num  1.86 1.91 1.93 2.03 2.04 ...
##  $ fyr   : Factor w/ 6 levels "2012","2013",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ Ws    : num  3.56 5.44 6.12 13.41 14.24 ...
##  $ Wr    : num  225 184 163 224 176 ...
##  $ gcat  : Factor w/ 4 levels "preferred","quality",..: 4 4 4 4 4 4 4 3 3 3 ...
```

```
headtail(lmb)
```

```
##     Year Site FID Weight Length AC AGE SexCon Sex Delts     logW     logL
## 1   2012   18  NA      8     72  2  NA     NA  NA    NA 0.903090 1.857332
## 2   2012   18  NA     10     82  2  NA     NA  NA    NA 1.000000 1.913814
## 3   2012   18  NA     10     85  2  NA     NA  NA    NA 1.000000 1.929419
## 537 2017   18  NA   1400    438  3  NA     NA  NA    NA 3.146128 2.641474
## 538 2017    9  NA   1362    464  3  NA     NA  NA    NA 3.134177 2.666518
## 539 2017    4  NA   1250     NA  3  NA     NA  NA    NA 3.096910       NA
##      fyr          Ws        Wr      gcat
## 1   2012    3.556717 224.92655  substock
## 2   2012    5.443933 183.69074  substock
## 3   2012    6.123337 163.30965  substock
## 537 2017 1310.825145 106.80296 preferred
## 538 2017 1583.118232  86.03274 preferred
## 539 2017          NA        NA      <NA>
```

```
unique(lmb$Year)  ### See that there is no 2013
```

```
## [1] 2012 2013 2014 2015 2016 2017
```

Lets create a new variable for 20 mm length bins.

```
lmb %<>% mutate(lcat20 = lencat(Length, w = 20))
headtail(lmb)
```

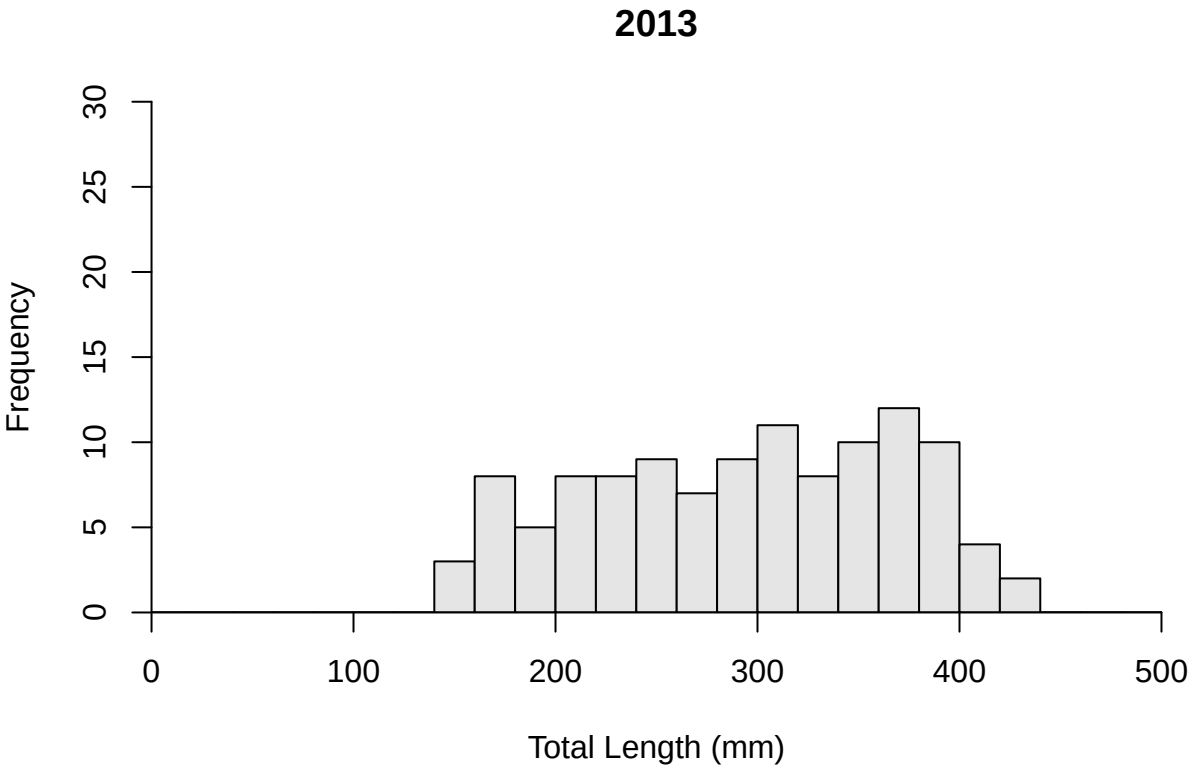
```
##     Year Site FID Weight Length AC AGE SexCon Sex Delts     logW     logL
## 1   2012   18  NA      8     72  2  NA     NA  NA    NA 0.903090 1.857332
## 2   2012   18  NA     10     82  2  NA     NA  NA    NA 1.000000 1.913814
## 3   2012   18  NA     10     85  2  NA     NA  NA    NA 1.000000 1.929419
## 537 2017   18  NA   1400    438  3  NA     NA  NA    NA 3.146128 2.641474
## 538 2017    9  NA   1362    464  3  NA     NA  NA    NA 3.134177 2.666518
## 539 2017    4  NA   1250     NA  3  NA     NA  NA    NA 3.096910       NA
##      fyr          Ws        Wr      gcat lcat20
## 1   2012    3.556717 224.92655  substock     60
## 2   2012    5.443933 183.69074  substock     80
## 3   2012    6.123337 163.30965  substock     80
## 537 2017 1310.825145 106.80296 preferred    420
## 538 2017 1583.118232  86.03274 preferred    460
## 539 2017          NA        NA      <NA>     NA
```

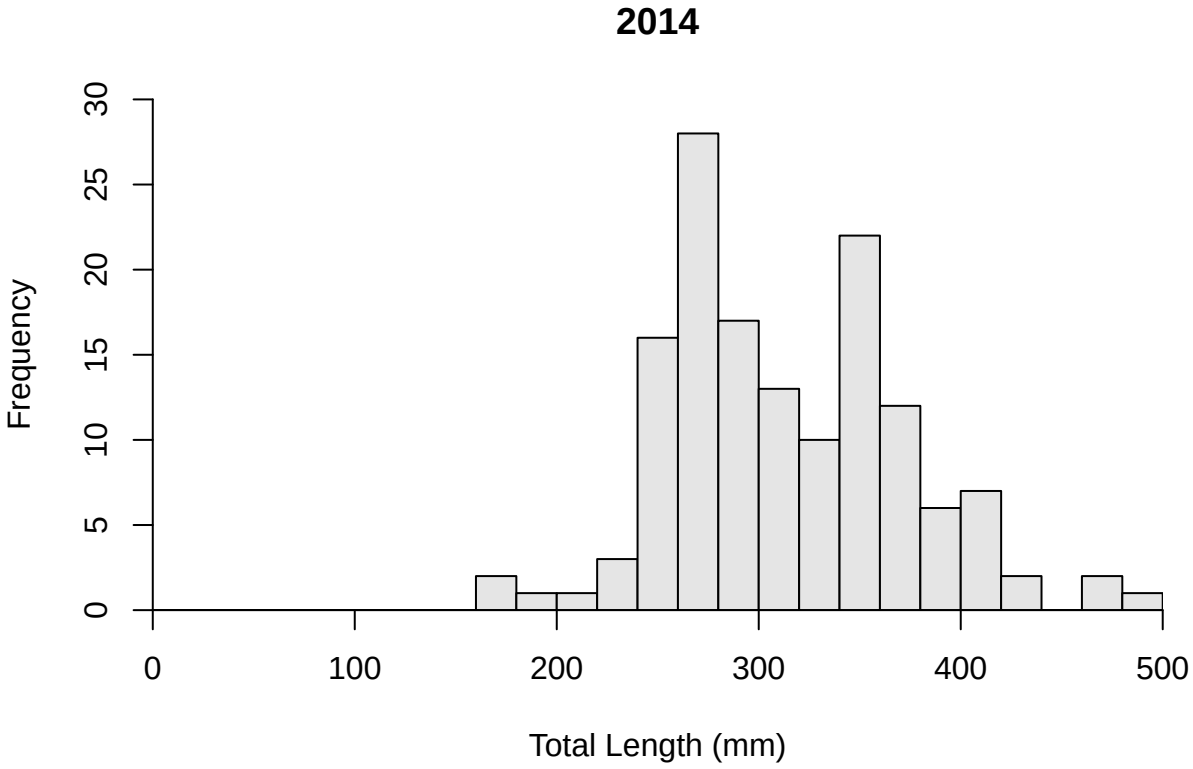
Now I want to separate out the years. I will throw out the year 2012 because samples from this years were not collected using the same procedures as in subsequent years. On ly large LMB from 2012 had length weigh data.

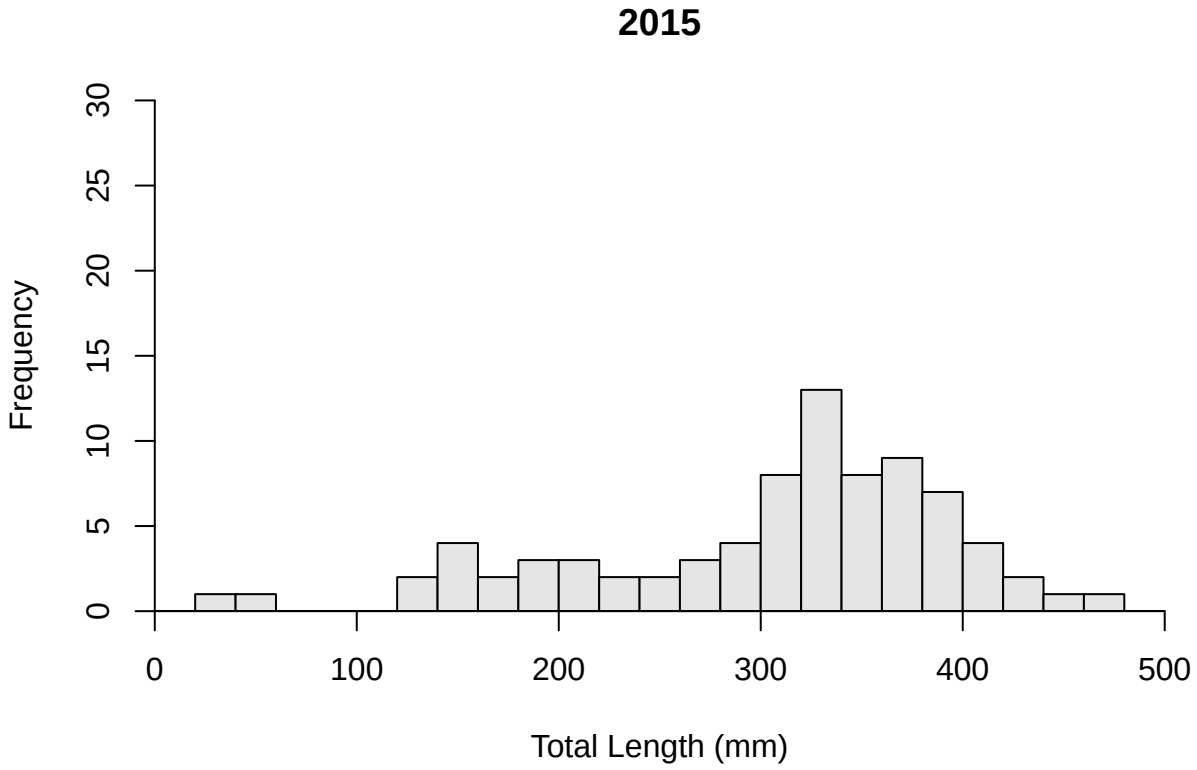
```
lmb.12 <- filter(lmb, Year == 2012)
# 1-8-2018#write.csv(lmb.12, file = 'Data/Clean-Data/minor-data/lmb.12.csv')
lmb.13 <- filter(lmb, Year == 2013)
# 1-8-2018#write.csv(lmb.13, file = 'Data/Clean-Data/minor-data/lmb.13.csv')
lmb.14 <- filter(lmb, Year == 2014)
# 1-8-2018#write.csv(lmb.14, file = 'Data/Clean-Data/minor-data/lmb.14.csv')
lmb.15 <- filter(lmb, Year == 2015)
# 1-8-2018#write.csv(lmb.15, file = 'Data/Clean-Data/minor-data/lmb.15.csv')
lmb.16 <- filter(lmb, Year == 2016)
# 1-8-2018#write.csv(lmb.16, file = 'Data/Clean-Data/minor-data/lmb.16.csv')
lmb.17 <- filter(lmb, Year == 2017)
# 1-10-2018#write.csv(lmb.17, file =
# 'Data/Clean-Data/minor-data/lmb.17.csv')
```

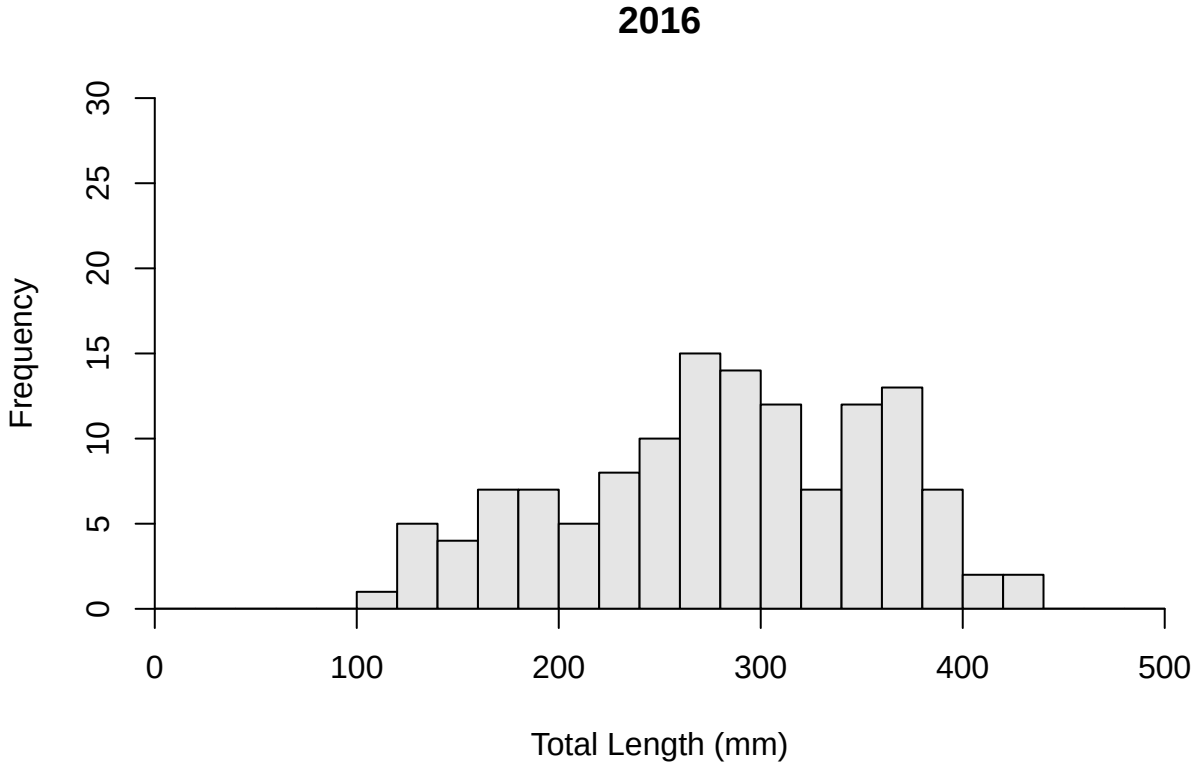
Length Frequency Distribution

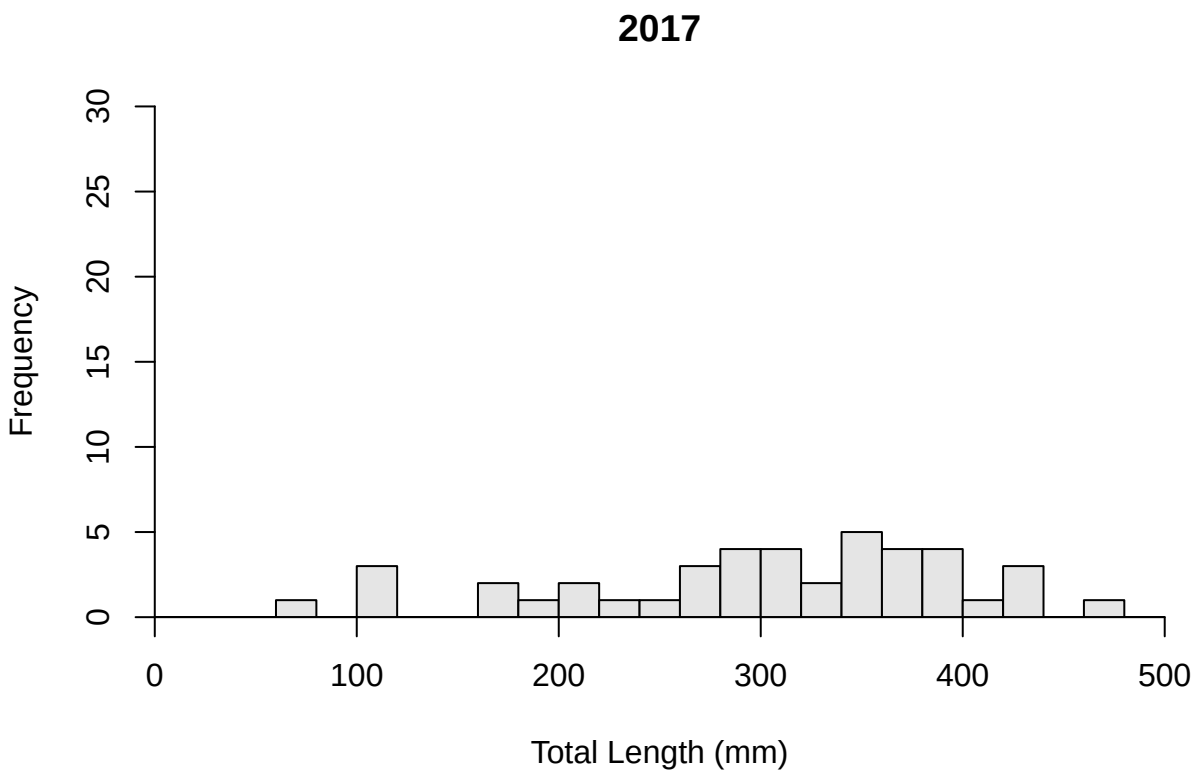
Lets view a quick histogram of the frequency of fish in each length bin.






2015
Frequency
0
5
10
15
20
25
30
0
100
200
300
400
500
Total Length (mm)

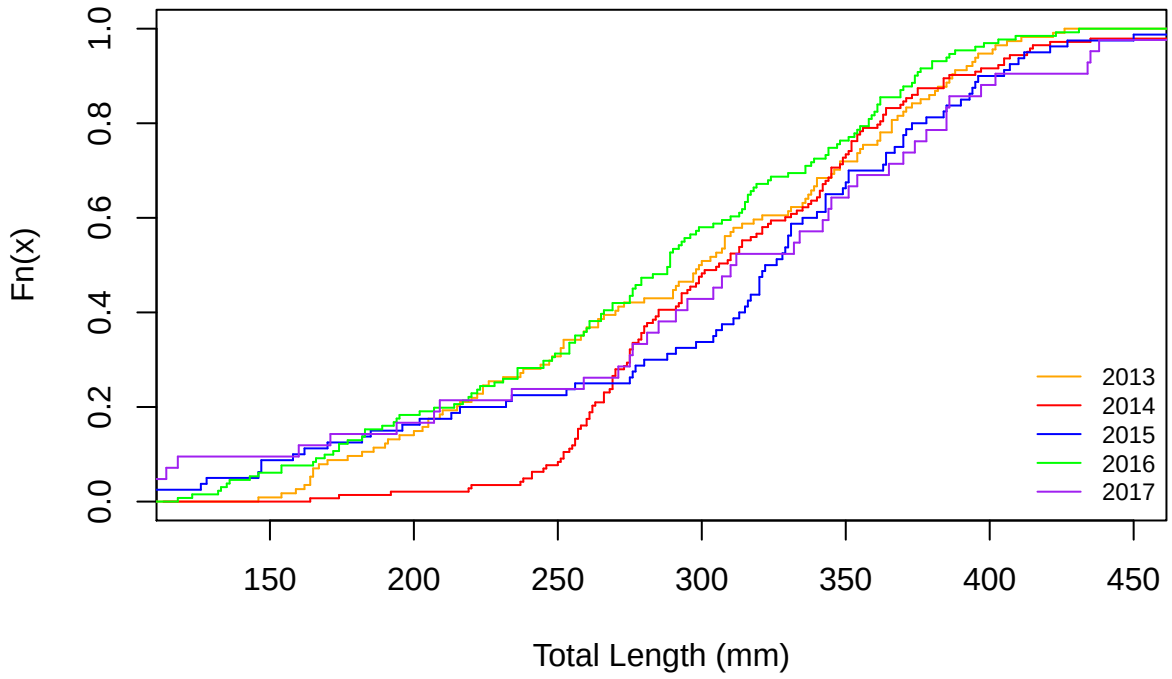

2016
Frequency
0
5
10
15
20
25
30
0
100
200
300
400
500
Total Length (mm)



There may be a problem where small fish (<100 mm) are not being captured by our gear dispite some being present in 2015. 2014 and 2016 look fairly similar to me and 2015 doesn't look too far off. With my limited expirience in these matters I would have to say the largemouth bass population looks stable. But lets continue to check this in a less qualitative manner.

Cumulative Frequencies

Lets look at the empirical cumulative distribution function (ECDF). This is the proportion of fish less than each observed length. This should help me compare the length frequency distributions between years.



Compare Length Frequency Between Years

Kolmogorov-Smirnov Test

```
(D <- c(ks.13.14$statistic[[1]], ks.13.15$statistic[[1]], ks.13.16$statistic[[1]],
    ks.13.17$statistic[[1]], ks.14.15$statistic[[1]], ks.14.16$statistic[[1]],
    ks.14.17$statistic[[1]], ks.15.16$statistic[[1]], ks.15.17$statistic[[1]],
    ks.16.17$statistic[[1]]))
```

```
##  [1] 0.23721016 0.19517544 0.09997322 0.14160401 0.19003497 0.24747771
##  [7] 0.20313020 0.24265267 0.13630952 0.17084696
```

```
(yrs <- c("13-14", "13-15", "13-16", "13-17", "14-15", "14-16", "14-17", "15-16",
    "15-17", "16-17"))
```

```
##  [1] "13-14" "13-15" "13-16" "13-17" "14-15" "14-16" "14-17" "15-16"
##  [9] "15-17" "16-17"
```

```
(p.yr <- data.frame(yrs, D, p.val))
```

```
##     yrs          D       p.val
## 1 13-14 0.23721016 0.007939765
## 2 13-15 0.19517544 0.147561368
## 3 13-16 0.09997322 0.576122817
## 4 14-15 0.19003497 0.147561368
## 5 14-16 0.24747771 0.002768099
## 6 15-16 0.24265267 0.023063064
```

Summary of Results

The results of the Kolmogorov-Smirnov test above seem to suggest the largemouth bass population is not stable (*Or is it? I think there are just a few weird years probably sampling related*). The length frequency distribution **is significant different** between the years 2013 and 2014 ($D = 0.24$, $P = 0.014$), 2014 and 2016 ($D = 0.25$, $P < 0.005$), and 2015 and 2016 ($D = 0.24$, $P = 0.046$). There is **no significant differnce**

between the length frequency distributions for 2013 and 2015 (D = 0.20, P = 0.344), 2013 and 2016 (D = 0.10, P = 1), and 2014 and 2015 (D = 0.19, P = 0.344). The length frequency distribution for the year 2017 was *not significantly different* between any years.

Note: *Adding in the Year 2017 Significantly Altered the Adjusted P-Values*